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Deep-sea Fishes of the Bermuda Oceanographic Expeditions.
Family Anguillidae.¹A. VEDEL TÅNING
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(Text-figure 1).

Dr. William Beebe has kindly entrusted to me the collection of leptocephalus stages of the European and American eels made off Bermuda during the years 1929-1931. As rather few eel larvae have been collected in the deep water very close to Bermuda, it was of interest to me to see this material procured during 1,350 hauls off Nonsuch Island.² The specimens are preserved in alcohol and are accordingly probably shrunk about 2 mm. as compared with specimens preserved in formalin.

The collection is small, comprising only 46 specimens, of which 29 belong to the European eel and 17 to the American eel. The specimens were collected during the months of May through September, none being taken in April and none in October or November when relatively few hauls were made.

Moreover, rather few hauls were carried out in the water layers in which we should expect most of these larvae, that is, in subsurface water in depths between 25 and 200 fathoms. Only about 60 hauls were made in these upper layers from May through September, as against about 1,100 in deeper water layers.

The eel larvae are, according to Johannes Schmidt's experiences, most frequently taken during night hauls and of these comparatively very few were made during the Nonsuch investigations. In the collection only three specimens of *Anguilla anguilla* were caught during night hauls.

The facts mentioned explain why so few eel larvae have been caught, and we may moreover emphasize that the small net commonly used (1-metre net) is not the best implement for the capture of eel larvae of a length greater than about 40 mm., as these are rather rapid stages which easily escape the net. This is especially the case with larval stages of the American eel, of which some in the collection are approaching the metamorphosis-stage; during the latter period they become very strong and rapid in their movements.

In regard to literature on the subject, I refer the reader to Schmidt's various publications mentioned in the Bibliography.

In the accompanying Tables I give various particulars concerning the material, such as myomere counts. A few show the total number of 112 and 113 myomeres, and as an overlapping in numbers may occur in the two

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² For detailed data in regard to nets, locality, dates, etc., refer to *Zoologica*, Vol. XIII, Nos. 1, 2 and 3.

species, it could be assumed that the identification is not quite certain. Since, however, the pre- and postanal number of myomeres and the blood vessels furnish some help in the identification and since the size of the larvae and the season of capture give further help, I am rather certain that the few specimens showing the number of myomeres mentioned are referred to the proper species.

Tables I and II show the sizes during the different months.

TABLE I.

TABLE II.

<i>Anguilla anguilla</i>						<i>Anguilla rostrata</i>				
Length mm.	May	June	July	Aug.	Sept.	May	June	July	Aug.	Sept.
53									1	1
52									1	
51	1								1	2
50										1
49										1
48		1							1	1
47			1							1
46		1							1	1
45		1		1					1	1
44					1					
43	2	1	1					1		
42										
41		1			1				1	
40										
39								1		
38										
37		1	1							
36			1	1						
35				3						
34				1	1					
33		1								
32		1								
31										
30			1							
29										
28			1							
27		2								
..										
..										
18			1							
Total	3	10	7	6	3			2	6	9

The larval stages belonging to the European eel (*Anguilla anguilla*) are easily referred to the year's brood (O-group) and the previous year's brood (I-group); probably a few of a length of about 36-37 mm. in June and July and a single one of 41 mm. in September should actually be referred to respectively the I-group and the O-group, but this is of minor importance.

It is well known that during the movement of the larval stages a few may be behind the main stock moving toward Europe and remain as the

I-group for some time in the western Atlantic; the 13 specimens measuring between about 41 and 50 mm. taken from May to September belong to this slow-moving (and late spawned) part of the I-group.

On the other hand, the 16 smaller specimens, between 18 and 37 mm. long, taken from June to September, belong most probably to the faster-moving (and early spawned) part of the O-group which have already reached the vicinity of the Bermudas in June.

In considering now Table II, which shows the lengths of larval stages of the American eel (*Anguilla rostrata*) taken during the months mentioned, it is immediately obvious that these arrive in the Bermuda area later, in July and August, and are of larger size than those of the O-group of the European eel; this is quite in agreement with the fact that the breeding place of the American eel is situated more to the southwest than that of the other species, and that the spawning takes place earlier in the year.³ According to Schmidt, metamorphosis takes place at a length of 60 to 65 mm. in the American eel. As is well known, the Bermuda fresh water eel is the American, not the European species. In regard to this, see William Beebe and John Tee-Van, "American Fresh-water Eels in Bermuda," *Bull. N. Y. Zool. Soc.*, Vol. XXXVII, 1934, pp. 181-183, and Johs. Schmidt, 1909, pp. 17-18.

The following table (Table III) gives a review of the actual number of larval stages taken in the different months and the number per 100 hauls. It is obvious that the European species is most common from June to August, and the American only during August and September. Actually, however, we know but very little concerning conditions during the months from October to April, and it would certainly be most interesting to get investigations also carried out during these months.

TABLE III.

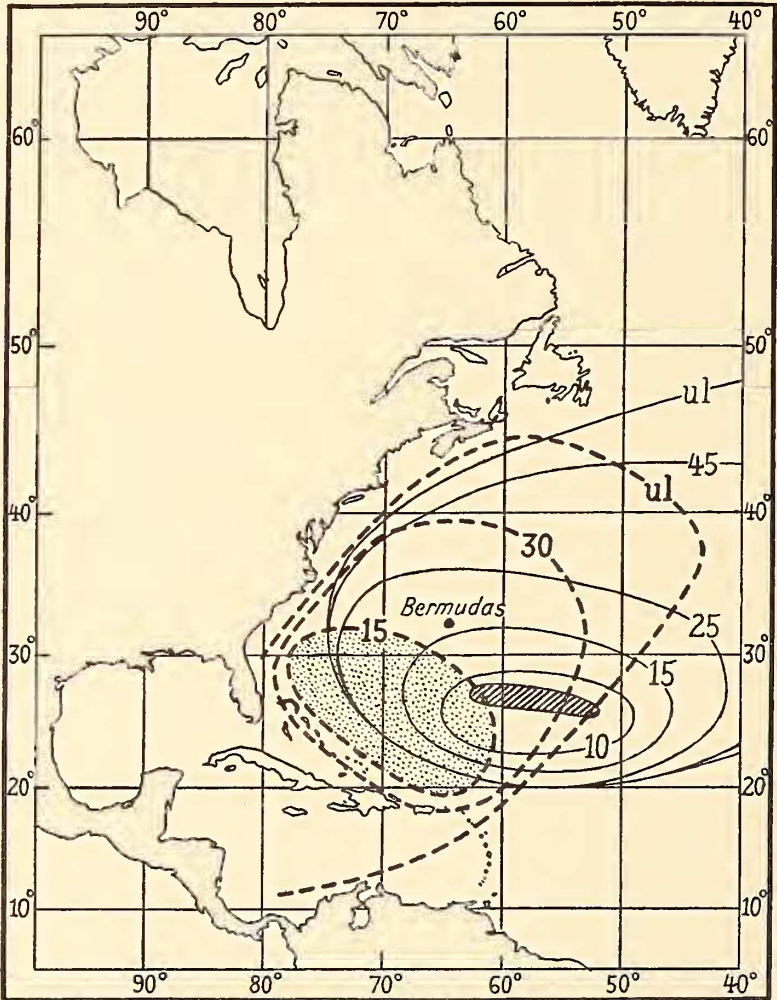
	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
Total No. of hauls 1929-31.....	63	214	260	236	192	362	15	8	1,350
No. of <i>Anguilla anguilla</i>	0	3	10	7	6	3	0	0	29
No. per 100 hauls.....	..	1.4	3.8	2.9	3.1	0.8	..	..	2.2
No. of <i>Anguilla rostrata</i>	0	0	0	2	6	9	0	0	17
No. per 100 hauls.....	..	..	..	0.8	3.1	2.5	..	..	1.2

As in other areas of the Sargasso Sea the number of larval stages of *Anguilla anguilla* surpasses that of *A. rostrata*.

As to the relative frequencies in the different months and in different depths, the following table (Table IV) gives a clear review, showing that the larval stages of the European eel are by far the most common in the

³ It is unlikely that the American eel spawns so close to Bermuda that eggs and young larvae could be met with there; at any rate post-larval stages smaller than 15 mm. have not yet been captured near Bermuda. Johannes Schmidt has previously (*The Danish "Dana" Expeditions 1920-22*, No. 1, p. 16, footnote, 1929) pointed out that the eggs without oil globule described by M. P. Fish (*Zoologica*, Vol. VIII, No. 5, p. 289 ff.) cannot be eggs of *Anguilla rostrata*. I have myself hatched eggs of the same or a very similar type and I am most inclined to refer the eggs in question to the Muraenoid species of which the larval stage is known as *Leptocephalus similis*. The information obtained by the 1,350 hauls made by Dr. Beebe off Bermuda supports the view that *Anguilla rostrata* propagates at a considerable distance from these islands.

subsurface waters off Bermuda from May through July, very few occurring in the deeper strata, where, however, the larval stages of the American eel are most commonly taken during August and September, owing probably also to the fact that the fishing during daytime in the lighter subsurface layers of the water is not able to catch the rapid stages of these larger sizes of American eel larvæ.



Text-figure 1.

Distribution in the western Atlantic of the different larval stages of the European and American eel. **Unbroken line** = European eel. **Broken line** = American eel. **Curves** show limits of occurrence: e.g., larvae less than 10 mm. have only been found inside the 10 mm. curve, etc. **ul:** curve showing limit of occurrence of unmetamorphosed larvae. **Striated area:** only place where the newly hatched larvae (5-7 mm. long) of the European eel have been recorded. American eel larvae less than 15 mm. have never been taken outside the **dotted area;** the actual spawning place inside the dotted area is, however, not yet known. (Redrawn from Schmidt, 1935).

TABLE IV.

Depth		Total No. of hauls		<i>A. anguilla</i>				<i>A. rostrata</i>			
Fathoms	Metres	May-July	Aug.-Sept.	May-July		Aug. Sept.		May-July		Aug.-Sept.	
				No.	No. per 100 hauls	No.	No. per 100 hauls	No.	No. per 100 hauls	No.	No. per 100 hauls
25-200	c.45-370	43	20	11	25.6	1	5.0	0	0.0	0	0.0
> 300	> c.550	606	506	9	1.5	8	1.6	2	0.3	15	3.0

Though the material to hand is very small it gives some valuable information as to the occurrence of the larval stages of the two species of fresh-water eels off Bermuda, and I wish to emphasize that the area is obviously very interesting for studies on the rate of growth and movement of the eel larvæ. Further studies would certainly give us much information which otherwise will be difficult to obtain. A glance at the small map (Text-fig. 1) will show immediately how excellent the position of Bermuda is for these studies.

I take this opportunity of thanking Miss Esther Hansen for valuable assistance.

STUDY MATERIAL.

The following list gives the catalogue number, net, depth in fathoms, date, length and myomere count of each *Anguilla leptcephalus* taken by the Bermuda Oceanographic Expeditions. All were caught in the cylinder of water off the Bermuda coast described in *Zoologica*, Vol. XVI, No. 1, p. 5.

Anguilla anguilla.

- No. 9,858; Net 85; 200 fathoms; May 5, 1929; 50 mm.; 72+46 (118) myom.
 No. 9,895; Net 90; 200 fathoms; May 11, 1929; 43 mm.; 70+45 (115) myom.
 No. 9,895a; Net 90; 200 fathoms; May 11, 1929; 43 mm.; 68+48 (116) myom.
 No. 11,046; Net 227; 800 fathoms; June 27, 1929; 32 mm.; 73+44 (117) myom.
 No. 11,075; Net 229; 1,000 fathoms; June 27, 1929; 43.5 mm.; 71+42 (113) myom.
 No. 11,184; Net 245; 800 fathoms; July 1, 1929; 30.5 mm.; 73+40 (113) myom.
 No. 11,707; Net 313; 800 fathoms; July 22, 1929; 47.5 mm.; 73+43 (116) myom.
 No. 11,772; Net 320; 1,000 fathoms; July 23, 1929; 37 mm.; 70+44 (114) myom.
 No. 11,819; Net 326; 1,000 fathoms; July 24, 1929; 36.5 mm.; 71+45 (116) myom.
 No. 15,625; Net 657; 700 fathoms; June 2, 1930; 27 mm.; 74+41 (115) myom.
 No. 15,746; Net 683; 900 fathoms; June 7, 1930; 37.5 mm.; 71+44 (115) myom.
 No. 17,789; Net 839; 700 fathoms; Sept. 3, 1930; 41 mm.; 70+44 (114) myom.
 No. 18,351; Net 870; 100 fathoms; Sept. 11, 1930; 34.5 mm.; 68+44 (112) myom.
 No. 18,386; Net 874; 500 fathoms; Sept. 11, 1930; 44 mm.; 69+46 (115) myom.
 No. 20,985; Net 1035; 100 fathoms; June 25, 1931; 27.5 mm.; 70+43 (113) myom.
 No. 20,985a; Net 1035; 100 fathoms; June 25, 1931; 33 mm.; 69+44 (113) myom.
 No. 21,020; Net 1042; 100 fathoms; June 26, 1931; 45 mm.; 70+46 (116) myom.
 No. 21,020a; Net 1042; 100 fathoms; June 26, 1931; 41 mm.; 70+45 (115) myom.
 No. 21,043; Net 1047; 100 fathoms; June 27, 1931; 48 mm.; 71+45 (116) myom.
 No. 21,043a; Net 1047; 100 fathoms; June 27, 1931; 46 mm.; 71+46 (117) myom.
 No. 21,152; Net 1058; 300 fathoms; July 7, 1931; ca. 18 mm.; 66+47+ (113+) myom.
 No. 21,342; Net 1080; 100 fathoms; July 14, 1931; 44.5 mm.; 71+46 (117) myom.

- No. 21,342a; Net 1080; 100 fathoms; July 14, 1931; 28 mm.; 73+ca. 43 (ca. 116) myom.
 No. 21,858; Net 1129; 1,000 fathoms; Aug. 4, 1931; 34 mm.; 72+43 (115) myom.
 No. 22,233; Net 1166; 900 fathoms; Aug. 11, 1931; 45.5 mm.; 72+46 (118) myom.
 No. 22,409; Net 1184; 800 fathoms; Aug. 15, 1931; 35 mm.; 73+44 (117) myom.
 No. 22,760; Net 1192; 1,000 fathoms; Aug. 17, 1931; 36 mm.; 72+44 (116) myom.
 No. 22,934; Net 1244; 800 fathoms; Aug. 31, 1931; 35.5 mm.; 70+49 (119) myom.
 No. 22,905; Net 1245; 1,000 fathoms; Aug. 31, 1931; 35 mm.; 73+43 (116) myom.

Anguilla rostrata.

- No. 11,650; Net 305; 600 fathoms; July 16, 1929; 43.5 mm.; 68+39 (107) myom.
 No. 11,722; Net 314; 900 fathoms; July 22, 1929; 39.5 mm.; 67+39 (106) myom.
 No. 12,877; Net 406; 800 fathoms; Sept. 2, 1929; 51 mm.; 69+39 (108) myom.
 No. 13,125; Net 427; 900 fathoms; Sept. 5, 1929; 48 mm.; 68+40 (108) myom.
 No. 13,193; Net 435; 1,000 fathoms; Sept. 6, 1929; 51.5 mm.; 71+38 (109) myom.
 No. 13,343; Net 449; 1,000 fathoms; Sept. 9, 1929; 53 mm.; 71+39 (110) myom.
 No. 17,759; Net 835; 500 fathoms; Sept. 3, 1930; 49.5 mm.; 70+38 (108) myom.
 No. 18,029; Net 856; 800 fathoms; Sept. 6, 1930; 47.5 mm.; 69+39 (108) myom.
 No. 18,098; Net 862; 800 fathoms; Sept. 8, 1930; 50 mm.; 69+40 (109) myom.
 No. 18,549; Net 881; 600 fathoms; Sept. 12, 1930; 45 mm.; 69+38 (107) myom.
 No. 18,496; Net 883; 700 fathoms; Sept. 13, 1930; 46.5 mm.; 68+38 (106) myom.
 No. 22,305; Net 1169; 700 fathoms; Aug. 12, 1931; 51 mm.; 67+39 (106) myom.
 No. 22,306; Net 1172; 1,000 fathoms; Aug. 12, 1931; 53 mm.; 70+39 (109) myom.
 No. 22,667; Net 1209; 1,000 fathoms; Aug. 20, 1931; 41 mm.; 69+38 (107) myom.
 No. 23,039; Net 1217; 600 fathoms; Aug. 24, 1931; 48 mm.; 70+39 (109) myom.
 No. 23,040; Net 1240; 1,000 fathoms; Aug. 29, 1931; 45 mm.; 70+38 (108) myom.
 No. 23,707; Net 1325; 500 fathoms; Sept. 19, 1931; 52 mm.; 70+39 (109) myom.

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